Integrated Coral Observing Network (ICON)
and
# The Coral Reef Early Warning System (CREWS)

Vision Statement

Our vision is to serve as a model for all of NOAA in establishing the highest quality *in situ* coral reef monitoring network, and to provide the integration of near real-time *in situ*, satellite, radar and other data for ecological forecasting in coral reef ecosystems.

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A true interagency, international collaborative effort!
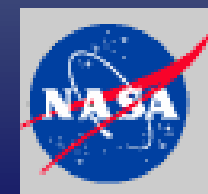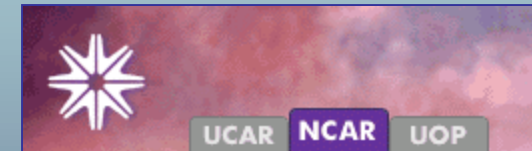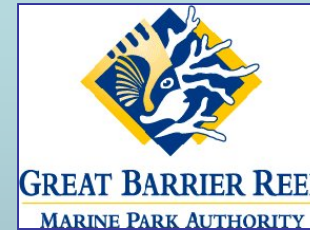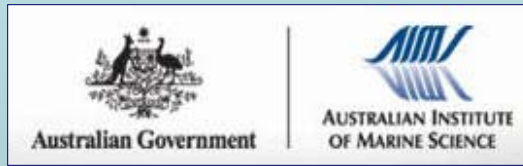
Goals

For the next few years, the ICON Program will be focusing upon:

- **Integrating data from diverse independent sources**

- **Ensuring consistency with NOAA's Integrated Ocean Observing System (IOOS), and the Coral Reef Ecosystem Integrated Observing System (CREIOS)**

- **Forging international partnerships**

- **Facilitating development and transition to operations of promising relevant *in situ* instrumentation**

Specific Objectives:

- Install CREWS Stations Within Coral Reef Ecosystems.

- Conduct Research on Coral Reef Ecosystems

- Tailor the ICON Information System to Support MPA Managers and the Coral Reef Research Community

Evolution of the ICON Program

SEAKEYS Network

AIMS Network

CREWS Software for Coral Bleaching Alerts[*]

• USCRTF Monitoring Working Group recommended establishing long-term data sets at 18 US coral reef areas and to utilize CREWS software for automated alerts.

• CRCP begins funding deployment of buoys and installation of stations in the Atlantic and the Pacific.

• Nickname adopted for stations utilizing software as "CREWS Stations"

* **Hendee, J.C., C. Humphrey, and T. Moore.** 1998. A data-driven expert system for producing coral bleaching alerts. *Proceedings, 7th International Conference on the Development and Application of Computer Techniques to Environmental Studies*, Las Vegas, Nevada, November 10-12, 1998. Computational Mechanics Publications/WIT Press, Southampton, 139-147.

Integrated Coral Observing Network (ICON)

G2 Software (HPCC funded application):

- **More powerful expert system (used by FBI, CIA, NSA, DOD, INMARSAT, etc.)**

- **Graphics and Web-oriented output .**

- **New off-the-shelf capabilities for near real-time data integration ("bridges").**

- **OPeNDAP* bridge possible (extra funding required).**

- **Integration of in situ, satellite, radar and other data sources.**

- **"Unveiling" of application at "MPA Retreat" meeting week of August 7, 2006**

* OPeNDAP = Open-source Project for a Network Data Access Protocol; provides software which makes local data accessible to remote locations regardless of local storage format. See http://www.opendap.org.

Existing stations…

- ### Lee Stocking Island, Bahamas (3)

  Data stream since May, 2001

- ### St. Croix, U.S. Virgin Islands

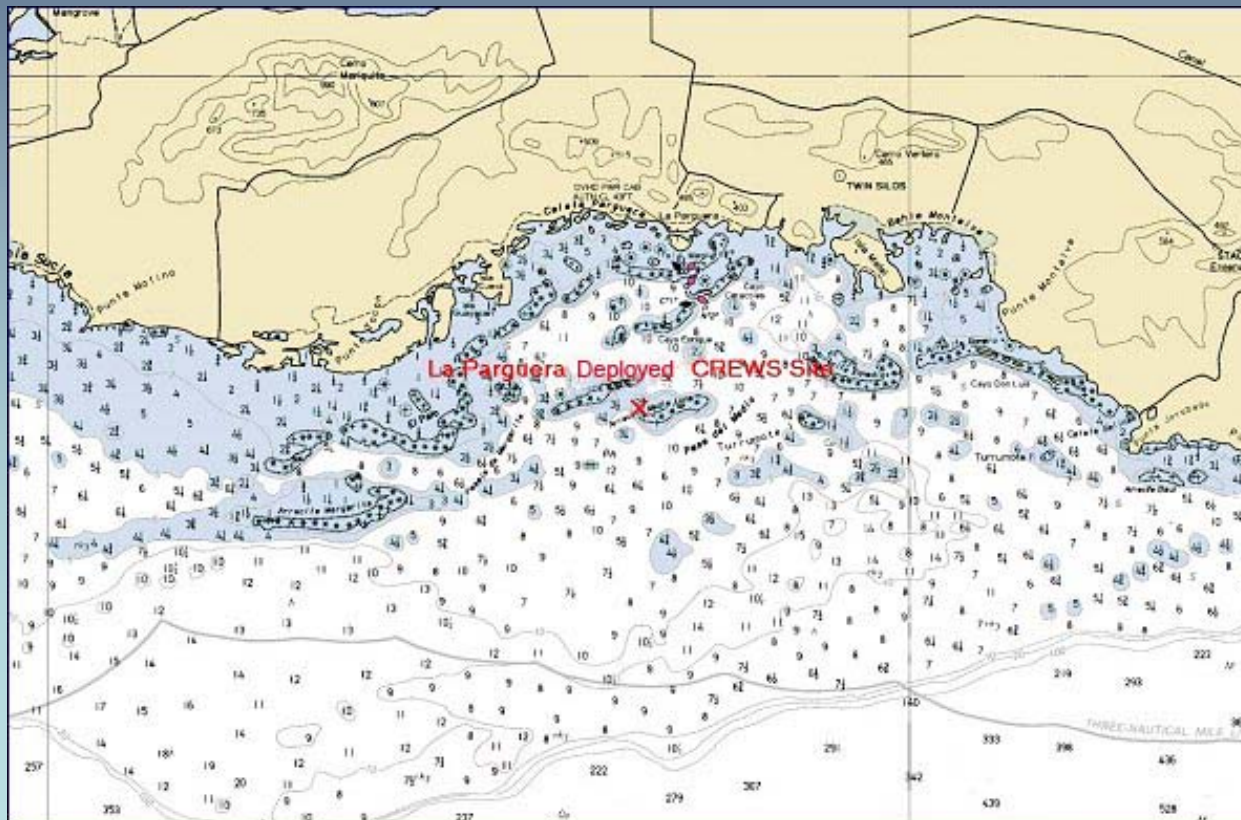 Data stream since June, 2002

- ### La Parguera, Puerto Rico

  Data stream since January, 2006

La Parguera, Puerto Rico

- Began transmitting data on January 14, 2006
- Site of new Caribbean Coral Reef Institute
- Site of new ocean acidification/pCO2 study, IOOS
- Recent Science Meeting big success
- Site of new Telemetered Instrument Array (TIA)

La Parguera Deployed CREWS Site

International Coral Reef Initiative (ICRI) stations in the works...

- **Heron Island, Queensland, Australia**
  Site survey completed November, 2005; bottom plate install August, 2006
- **Discovery Bay, Jamaica**
  Bottom plate installed February 27th
- **Puerto Morelos, Mexico**
  Site survey week of July 10, 2006
- **Little Cayman, Cayman Islands**
  Site survey week of June 5, 2006
- **Antigua, Lesser Antilles**
  Co-PI with Dr. Rod Zika of RSMAS
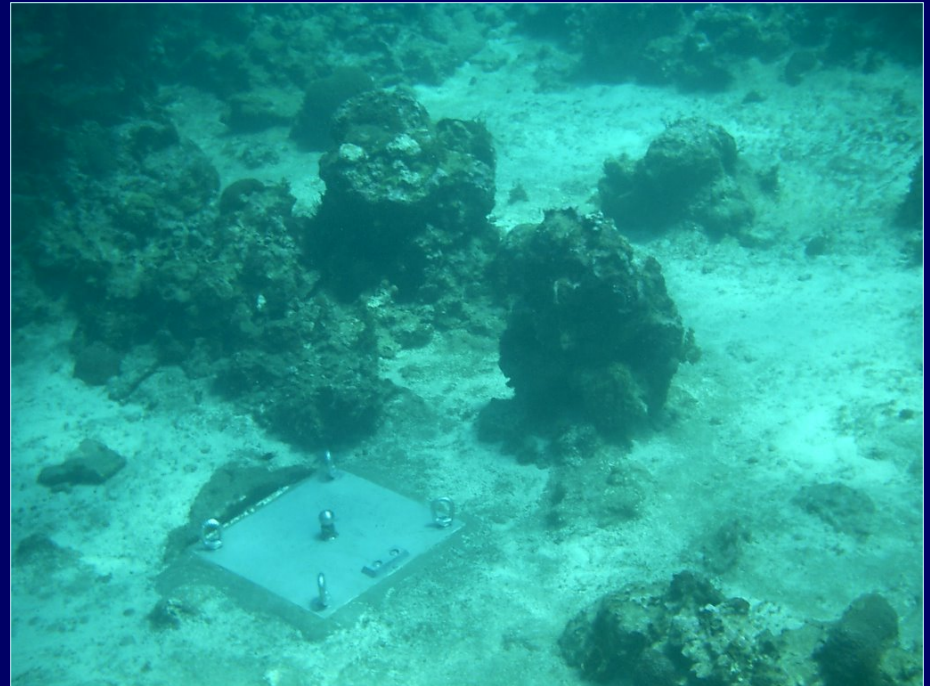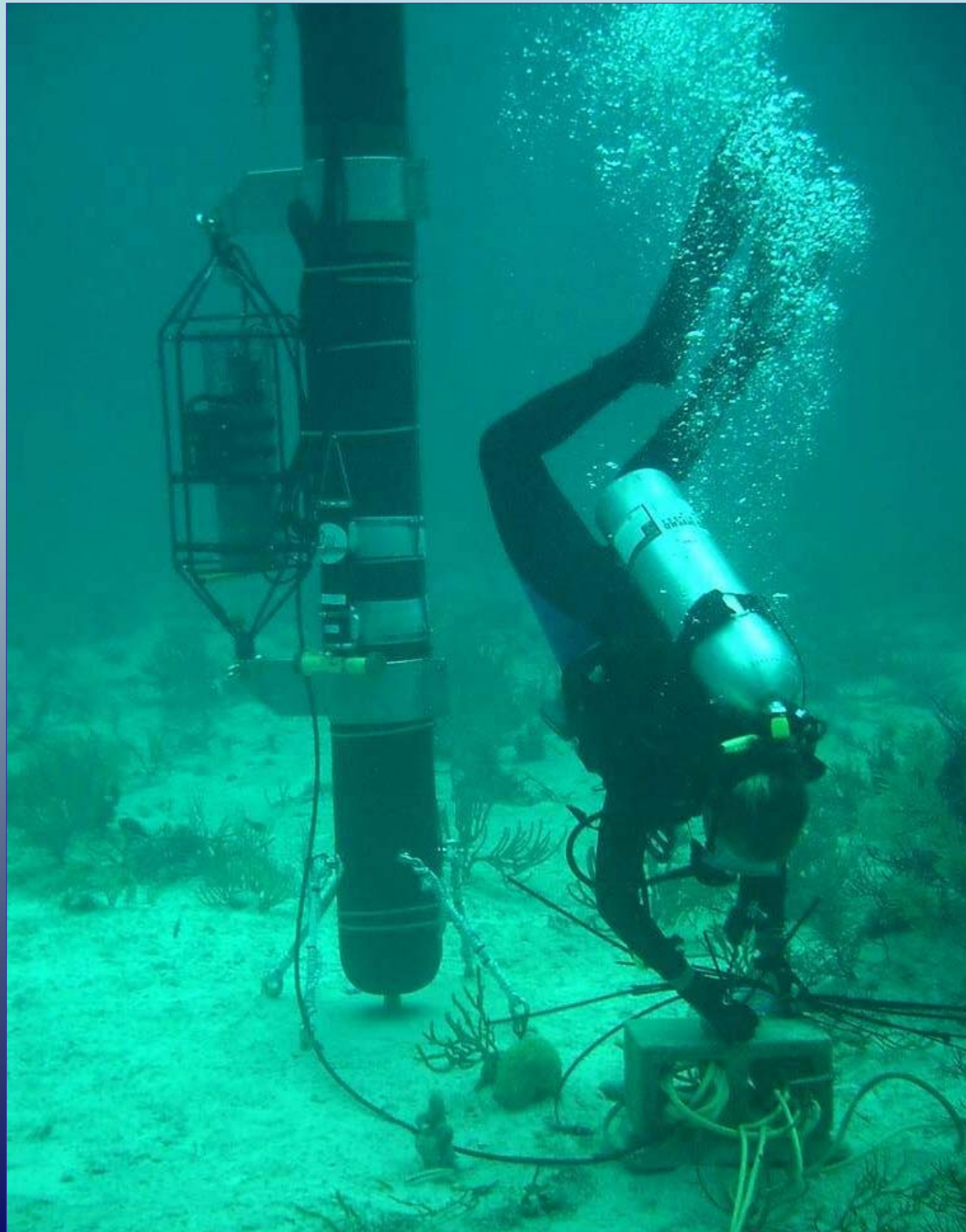
The Instruments

A stable pylon-style coral monitoring platform provides the opportunity to position instruments of various sizes, shapes and configurations at various heights above the ocean and depths throughout the water column.

Meteorological instruments measure air temperature, wind speed, barometric pressure, humidity, precipitation and light (PAR, UV).

Oceanographic instruments measure sea temperature, salinity and light (PAR, UV). Optional instruments have measured pCO2, Pulse Amplitude Modulating (PAM) fluorometry, and transmissometery. We have field-tested instruments measuring nutrients, and acoustic signals from fish and plankton.

Ecological forecasts **predict the impacts of physical, chemical, biological, and human-induced change on ecosystems and their components.**

New draft NOAA Technical Memorandum (Ecosystem White Paper #5) , "Near Real-Time Ecological Forecasting" is available upon request. Write to co-author Dr. Jim Hendee:

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ICON-relevant ecological forecasts (existing or planned for development):

- **Coral bleaching (high sea temperatures + high radiation)**

- **Coral disease (high nutrients + high temperatures)**

- **Spawning events (fish, coral and other invertebrates)**

- **Predicting larval transport and survival**

- **Predicting coral reef recovery after disturbance**

- **Pollution event and beach closure forecasting**

- **Forecasting likely oil spill movement**

- **Rainfall and run-off events (=> blooms, sedimentation)**

- **etc. (research models drive sensor deployment and forecasts)**

What's the diff?

Buoys	Pylons
Cost: ~$60K	Cost: $60K (but spares add $)
Requires large vessel	Requires small vessel, air travel
Easy deployment	Shallow deployment
Remote areas	Serviceable locally
Limited information	Lots of info, high bandwidth
Possible data discontinuity	Very good data continuity
Pull & replace buoy	Modular assembly & replacement
Instruments near surface	Instruments whole length of pylon

Coming up week of August 7, 2006:

"An MPA Retreat: Establishing Coral Reef MPA Managers' Requirements to Guide Integrative Observing System Tool Development"

- To be held at La Parguera, Puerto Rico

- Possibly up to 50 MPA Managers from the Atlantic and Caribbean

- Purpose is gain input from the managers in building new G2-based

   coral data integration Web interface for decision support

- Data types: CREWS stations, satellite, radar, biological monitoring, etc.

- Interesting note: there are over 315 MPAs in the Caribbean!

- *Ecological Forecasting* for MPAs will be main goal of the software

The Way Forward:

* Characterize the biology of each area

* Install sensors relevant to ecological stress and change:

  pCO_2, light, nutrients, PAM, acoustic monitoring, etc.

* Collect and integrate long-term data sets

  (*in situ*, satellite, radar, etc.)

* Investigate biota change with changing environment

* Implement research models in ICON for ecological forecasting

* Adjust models until we get good reproducibility

* Move models to operational capability: advise MPA Managers,

  researchers and the public
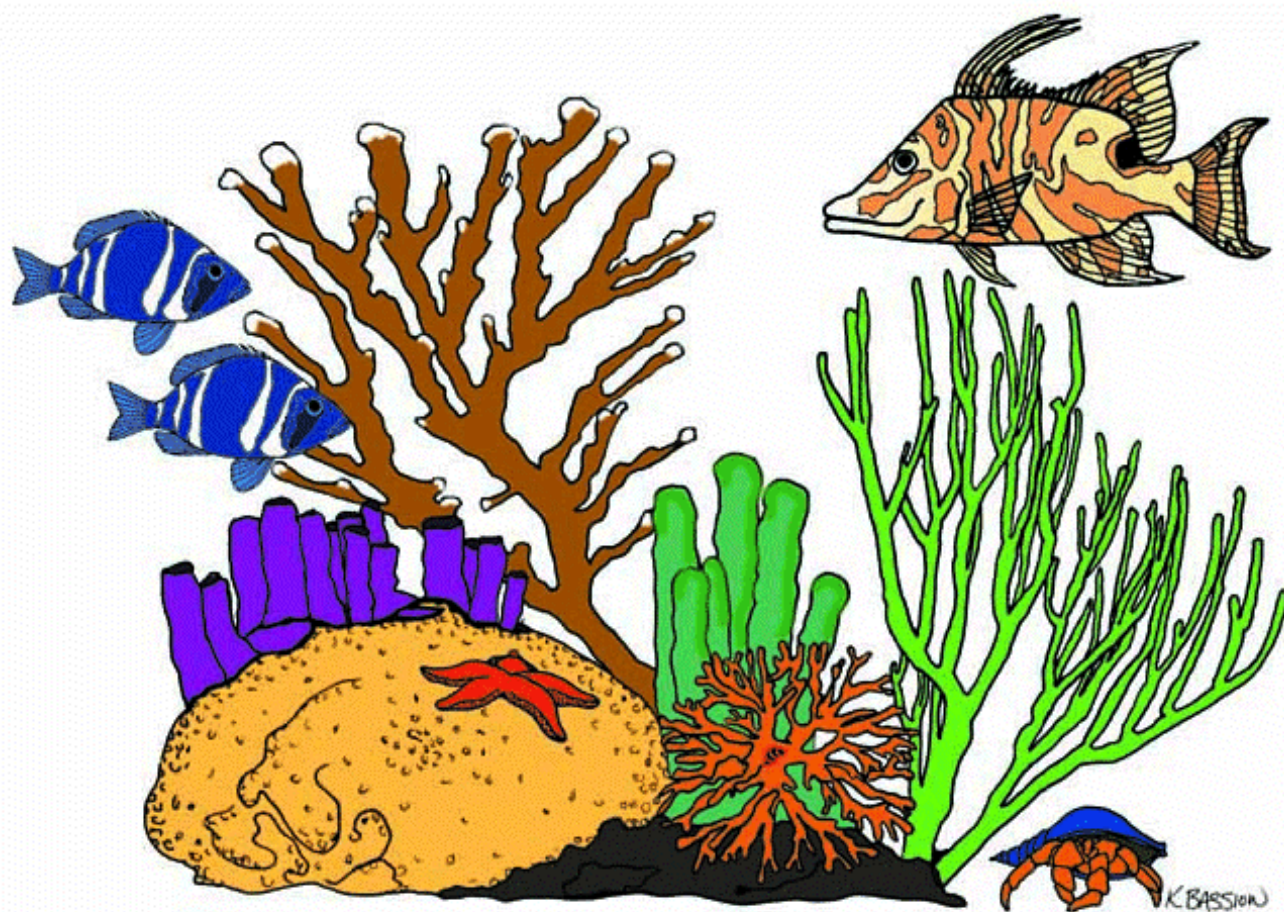
Coral Health And Monitoring Program

Integrated Coral Observing Network

K.BASSION